

SPS Singapore

Controlled missiles: Targeted treatment of tumors with engineered *E. coli*

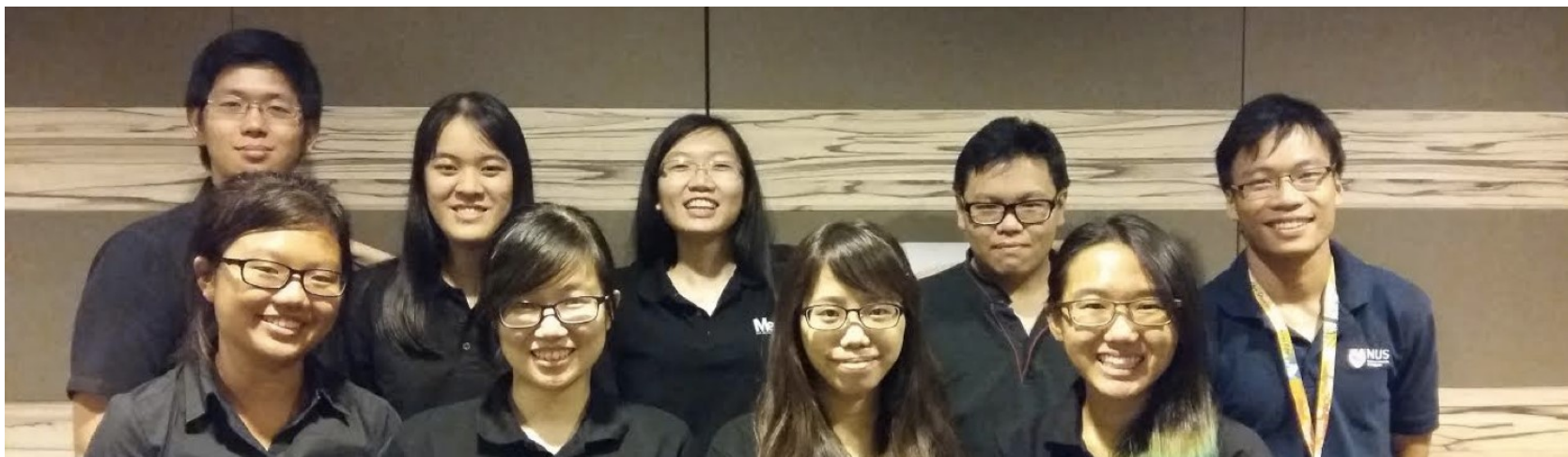
**Location of
SINGAPORE
in World**



www.mapsofworld.com



Team SPSingapore

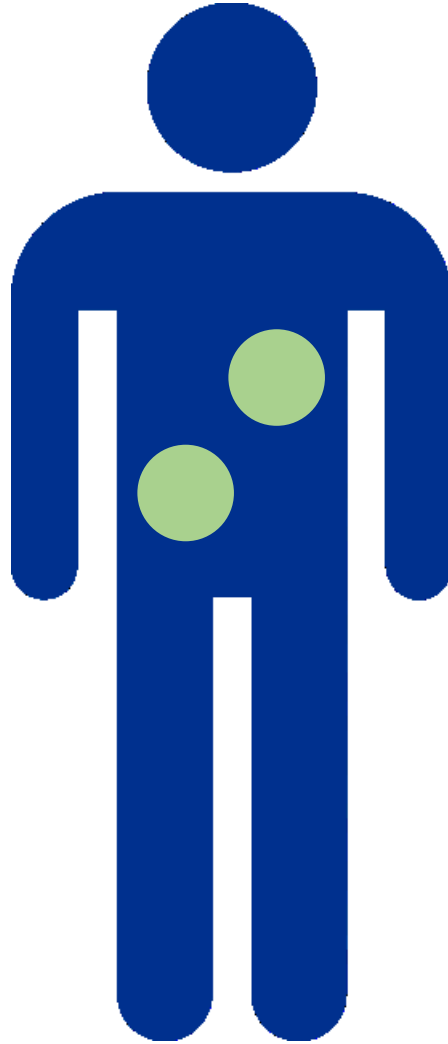


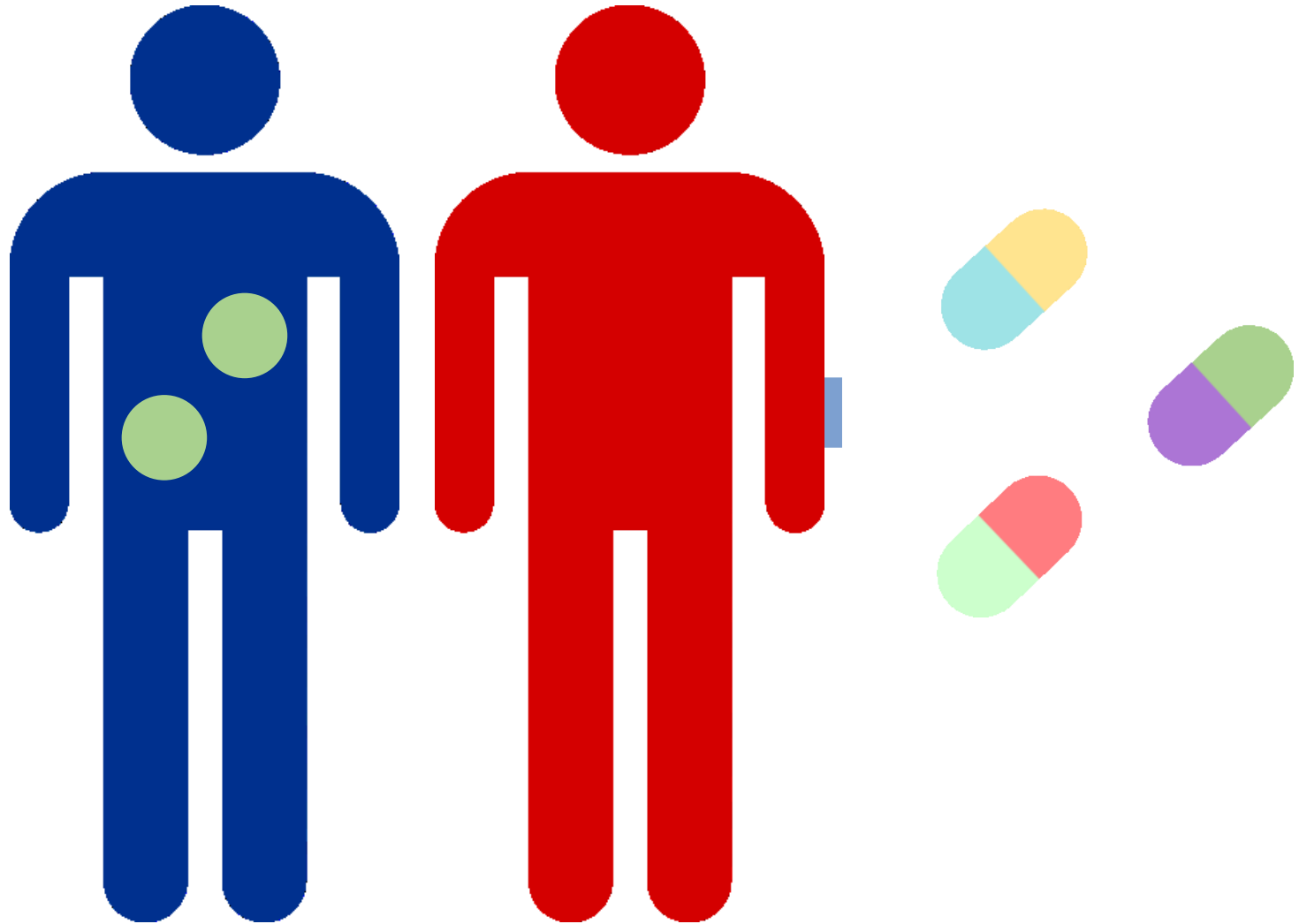
In a Nutshell

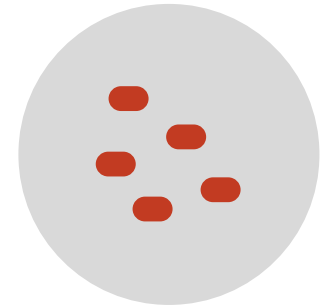
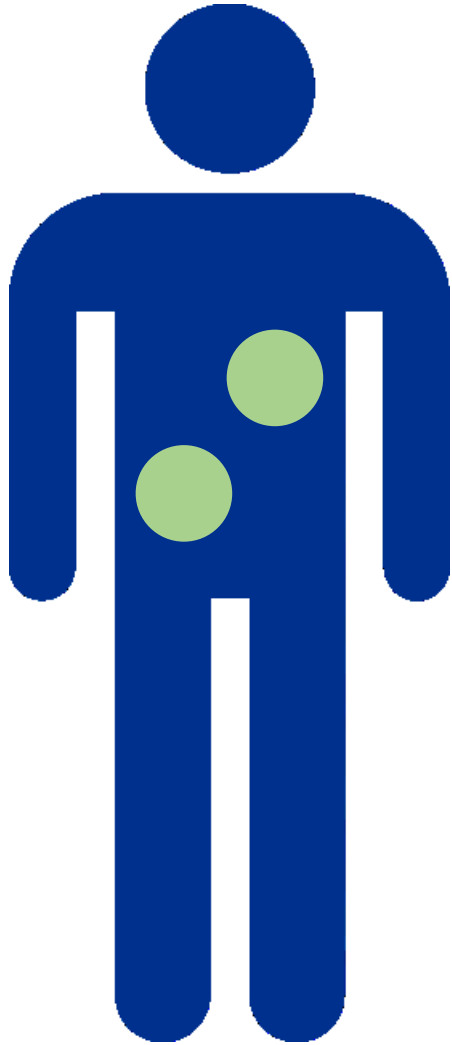
In a Nutshell

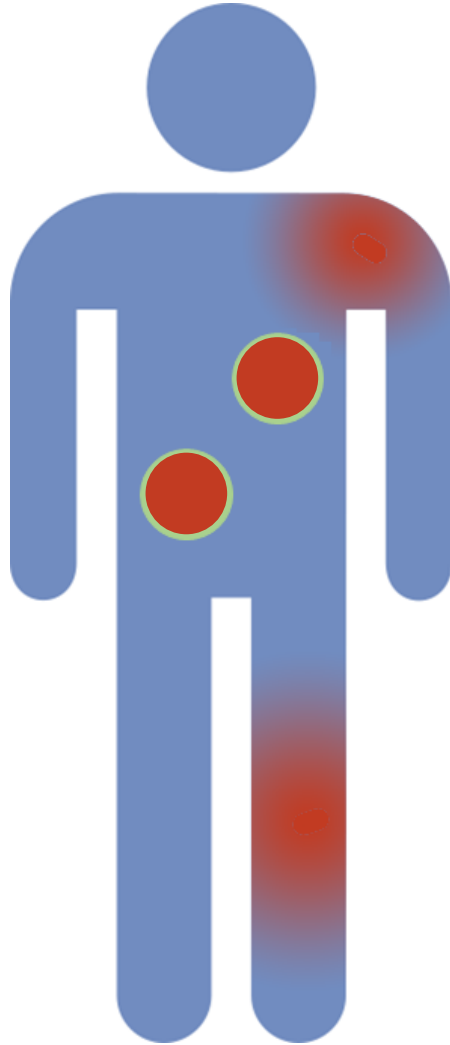
Biological Programming

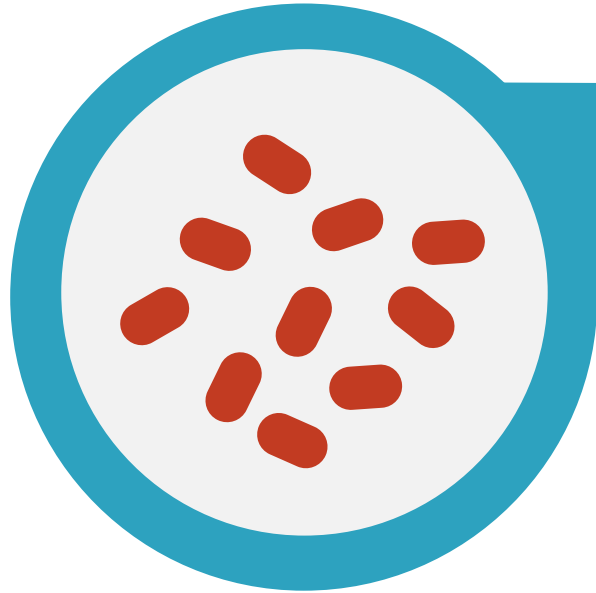
HP: Simplifying Circuits











Quorum Sensing

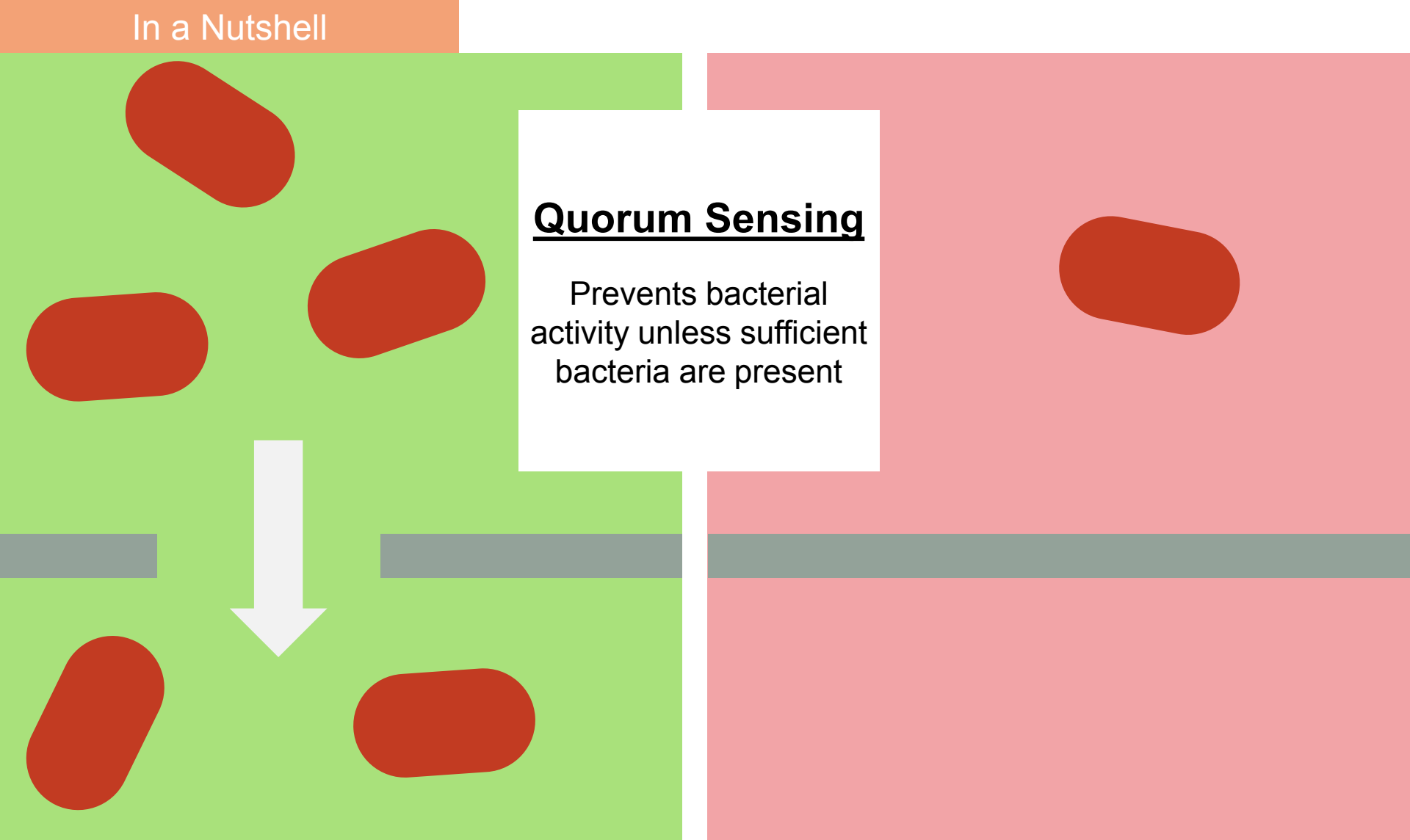
Anaerobic Switch



In a Nutshell

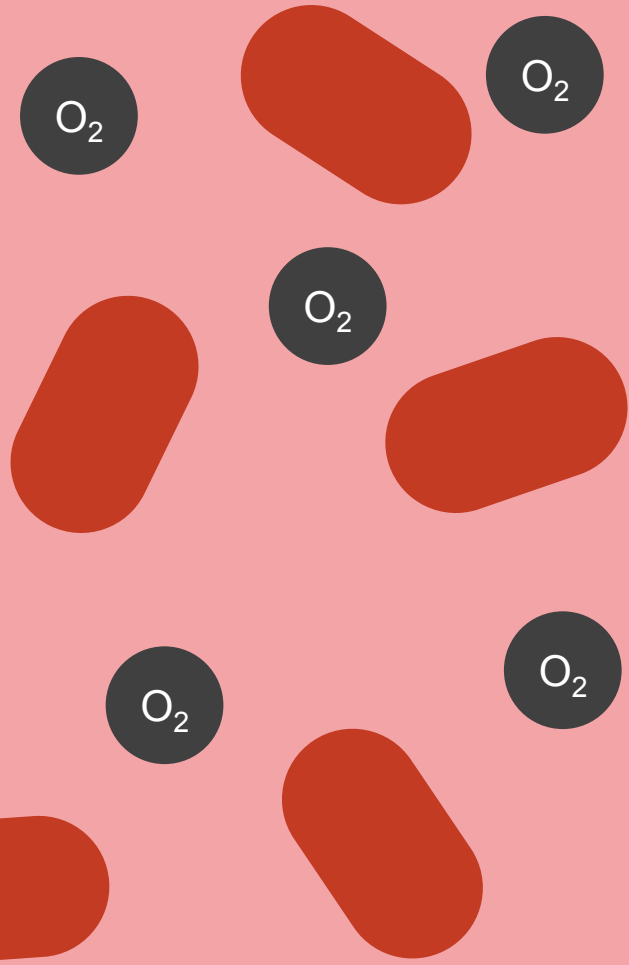
Quorum Sensing

Prevents bacterial
activity unless sufficient
bacteria are present



Anaerobic switch

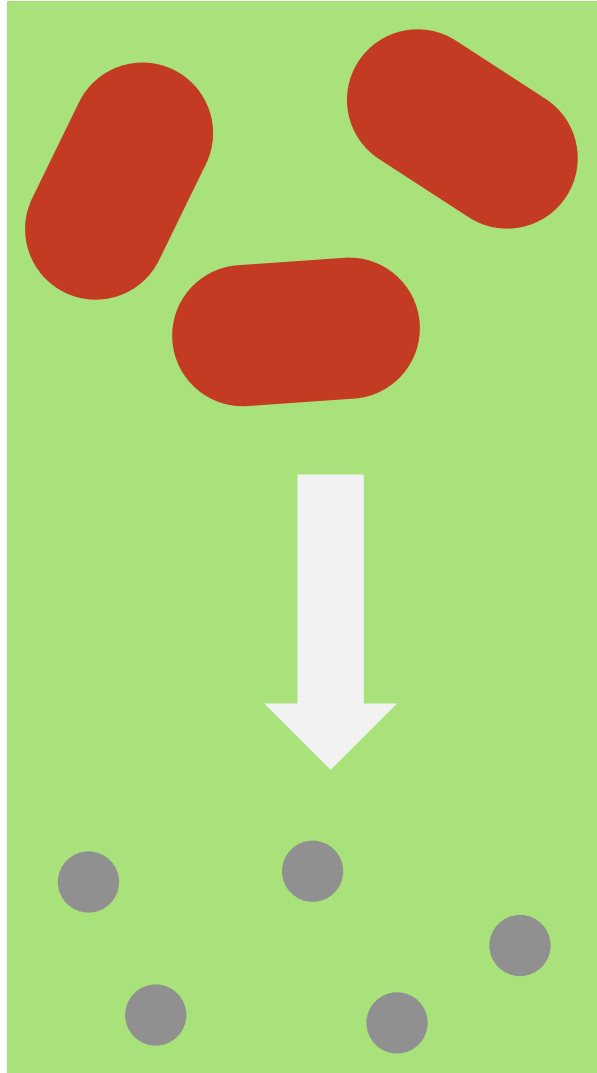
Prevents bacterial
activity outside of the
hypoxic tumour region





QS OFF
Anaerobic ON

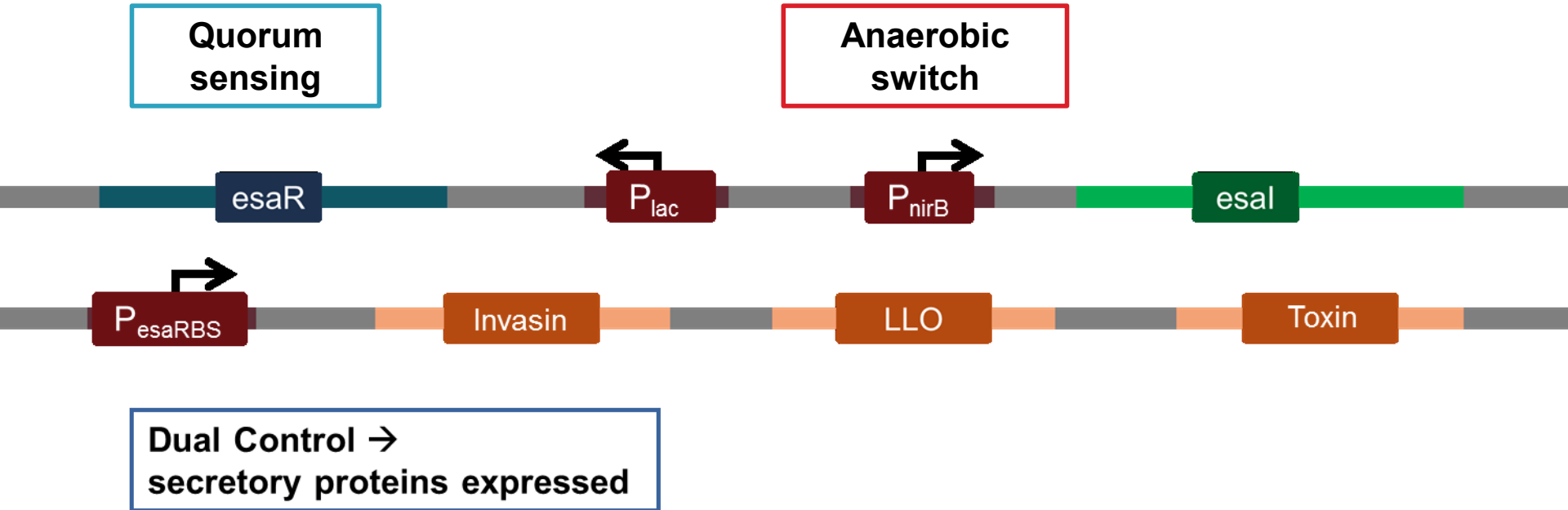
No expression



QS ON
Anaerobic OFF

No expression

In a Nutshell

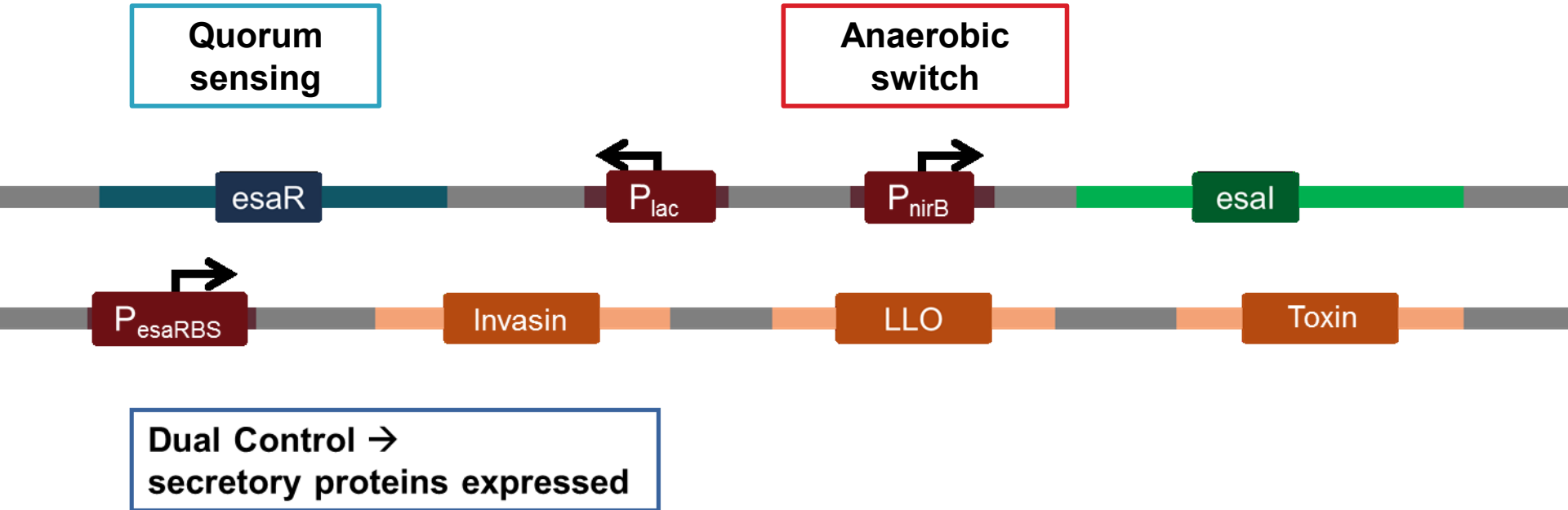


In a Nutshell

Biological Programming

HP: Simplifying Circuits

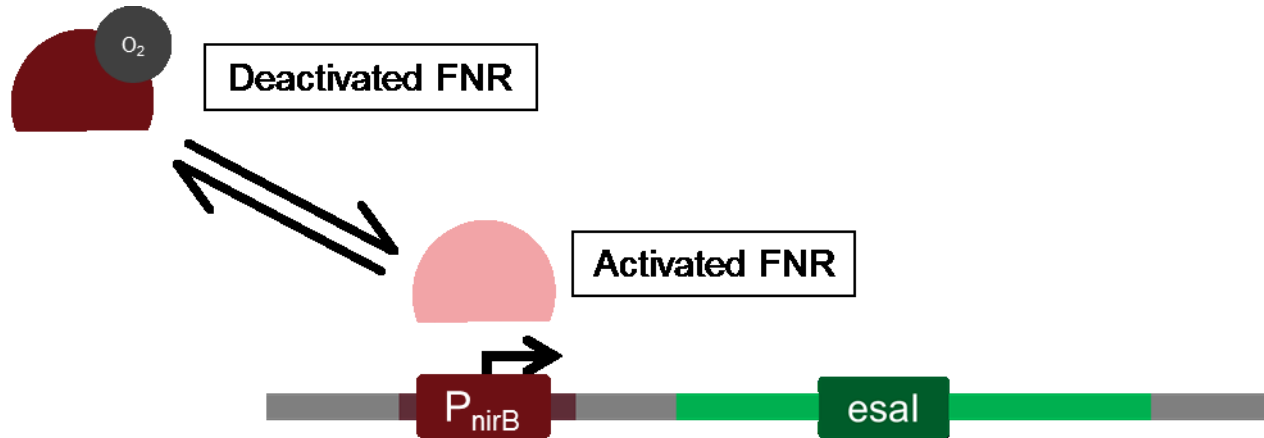
In a Nutshell



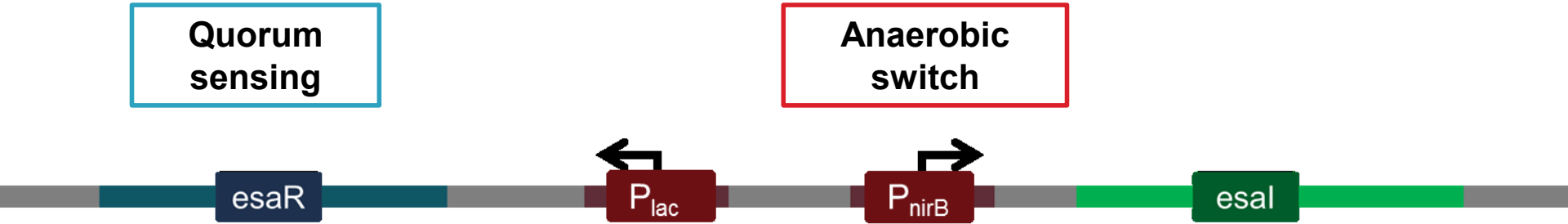


nirB/FNR anaerobic system

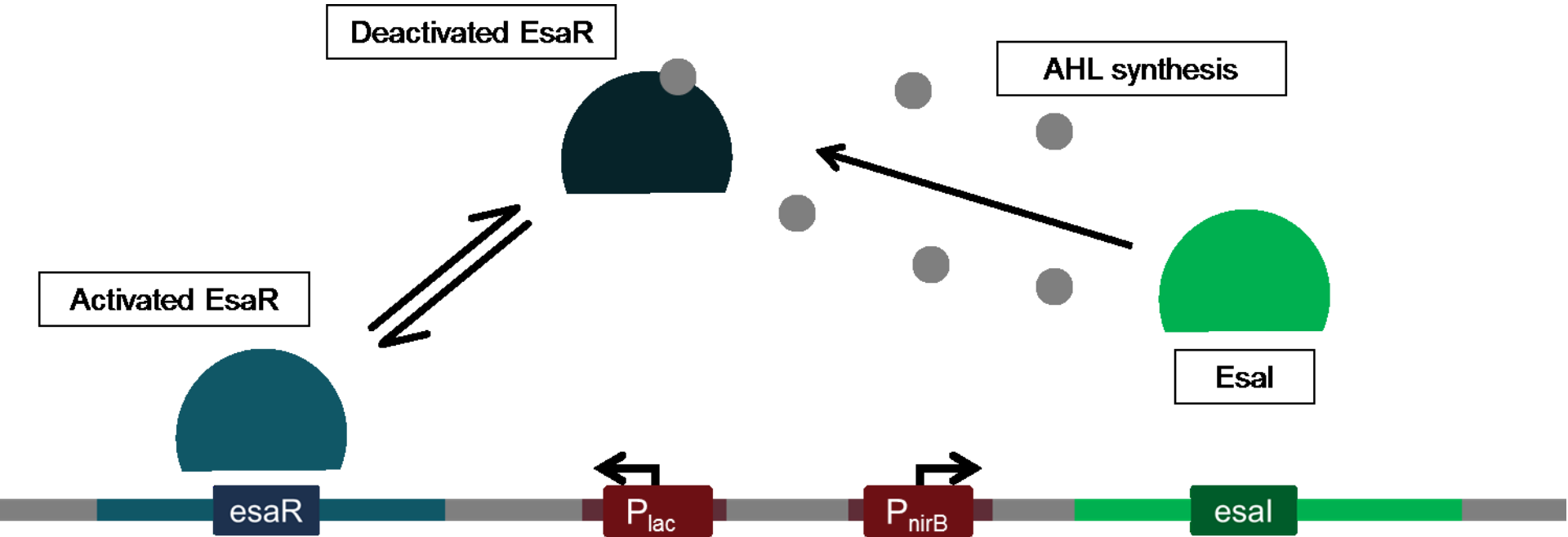
- *nirB* promoter is anaerobic-responsive



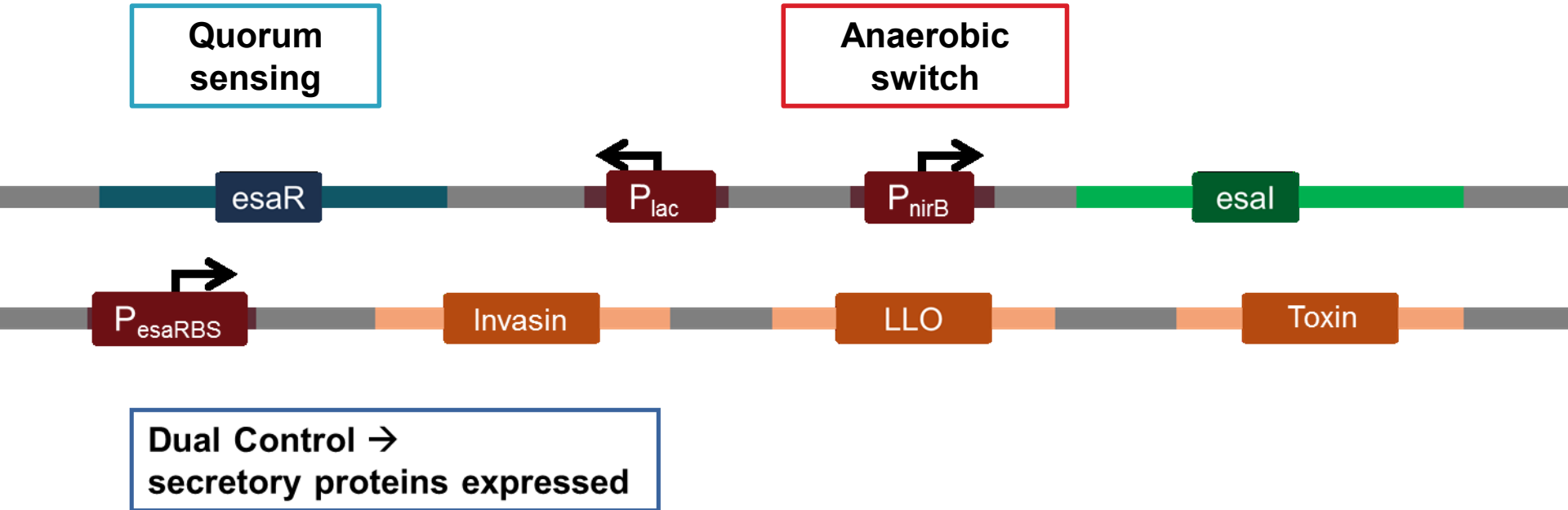
In a Nutshell



EsaR/EsaI quorum sensing system

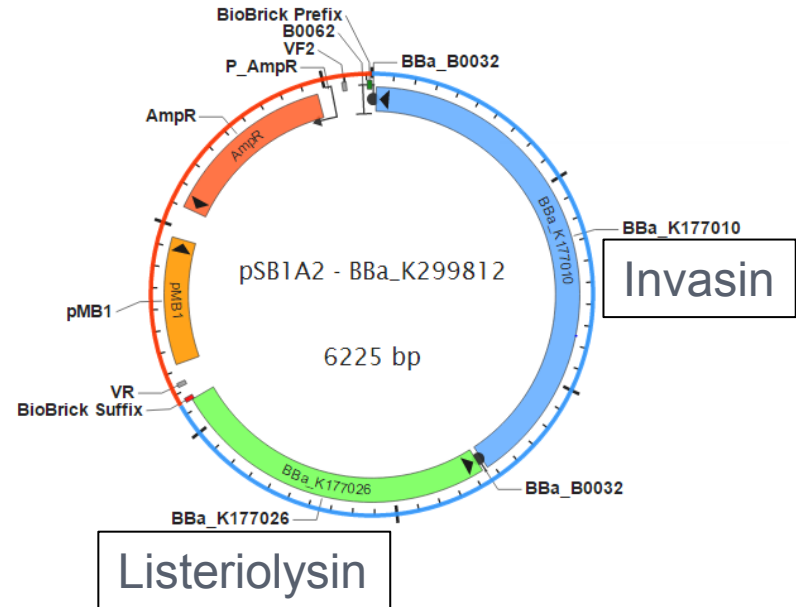


In a Nutshell



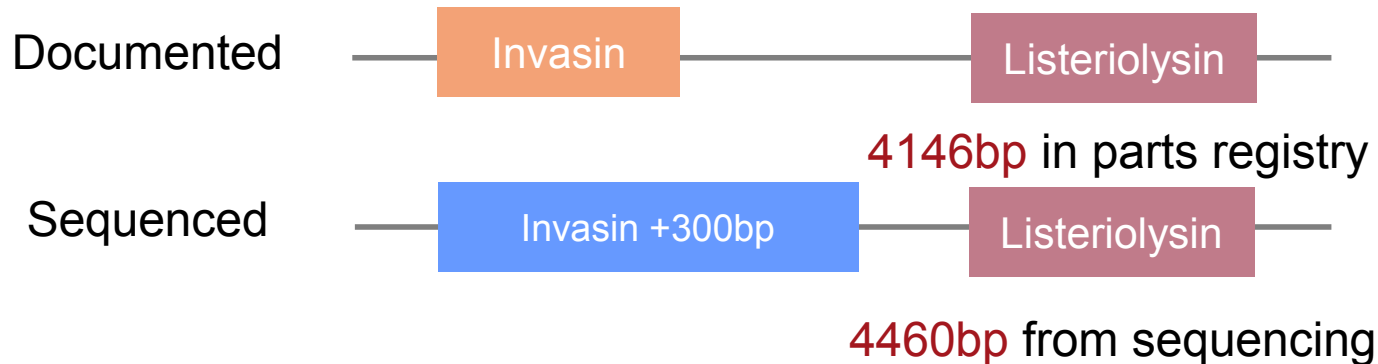
Invasin + Listeriolysin effector proteins

- Updated documentation of BBa_K299812
 - Sequence differs significantly from parts registry
 - BioBricks suffix is missing in construct (PstI only)



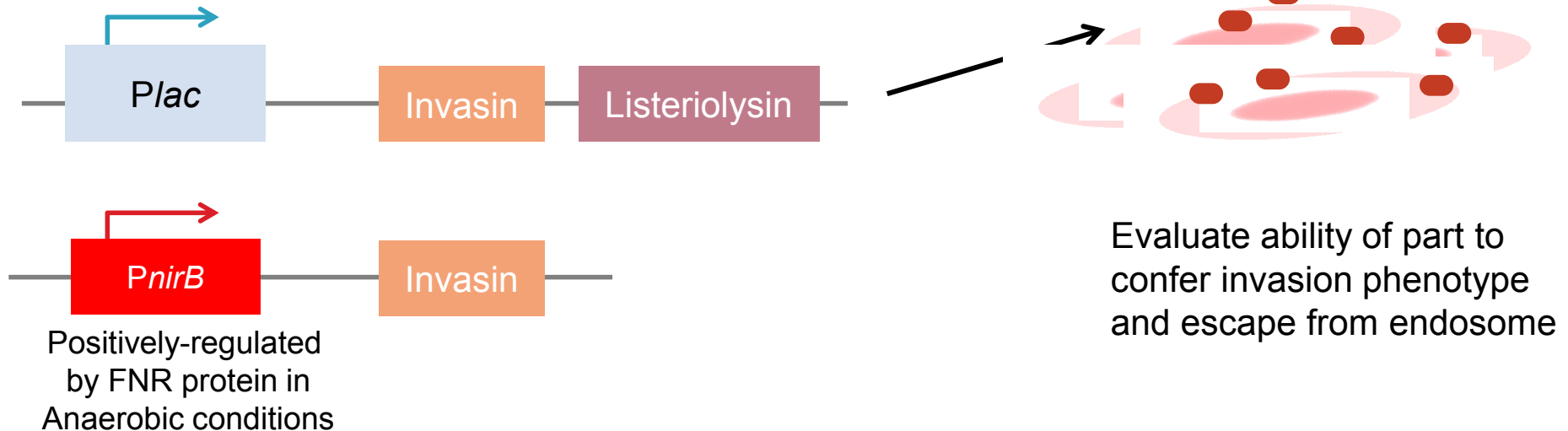
Invasin + Listeriolysin effector proteins

- Updated documentation of BBa_K299812
 - Listeriolysin is 'codon-optimised'
 - Invasin is 300bp longer
 - Invasin matches *Yersinia enterocolitica*



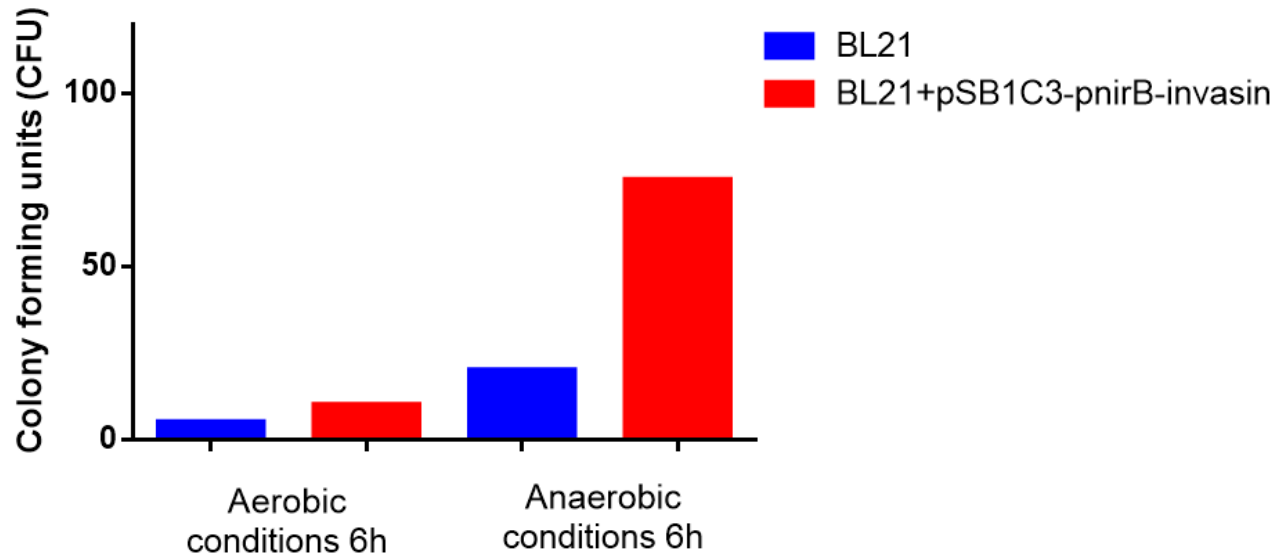
Invasin + Listeriolysin

- Constitutive expression of Invasin and Listeriolysin
(From BBa_K299812)



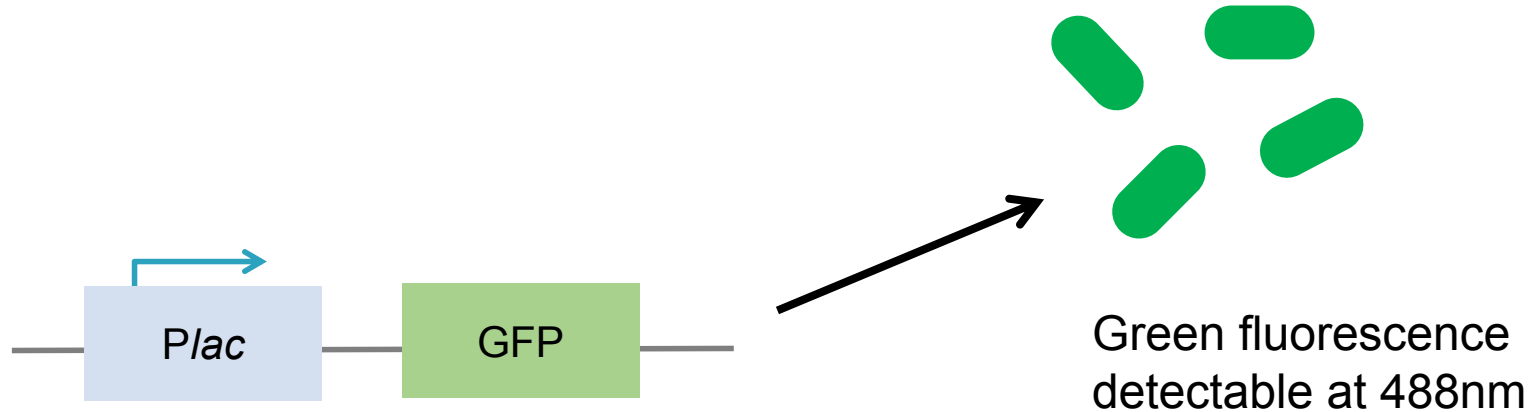
Testing our tools: *PnirB*-Invasin vector

- There was increased invasion under anaerobic conditions



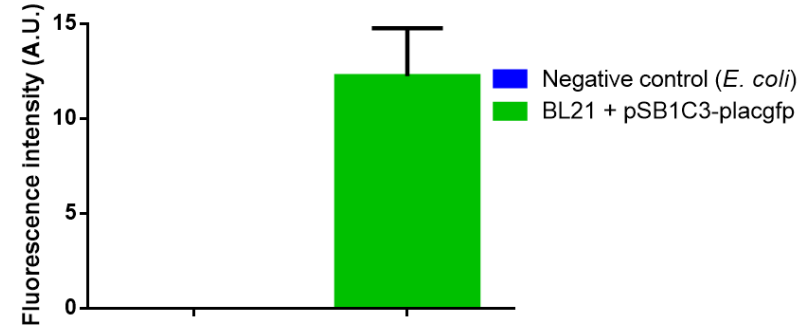
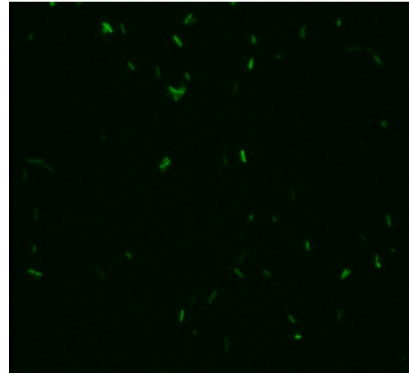
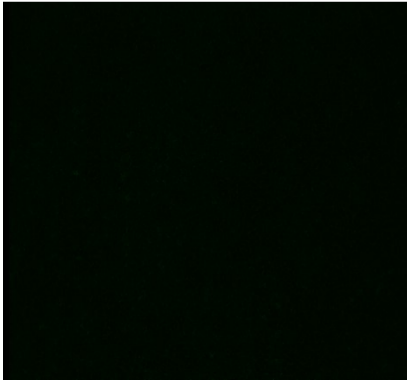
Testing our tools: *P/lac*-GFP

- *P/lac* promoter shows high basal expression



Testing our tools: *P*/*lac*-GFP

Untransformed *E. coli* pSB1C3-*P*/*lac*GFP



Submissions to parts registry

Registry ID	Name of Construct	Purpose
BBa_K299812	pSB1A2-inv-hly	Sequence confirmed sample
BBa_K1804001	pSB1C3- <i>p</i> <i>lac</i> -gfp	Constitutively expressing GFP
BBa_K1804002	pSB1C3- <i>pnirB</i>	<i>PnirB</i> Anaerobic promoter

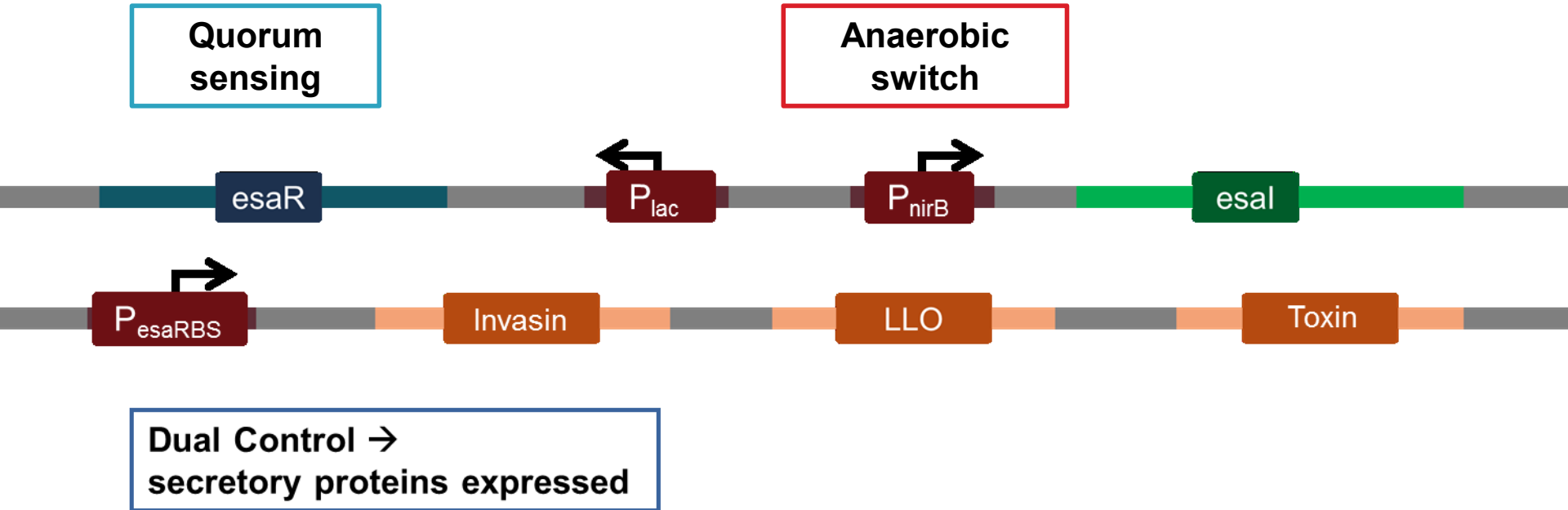


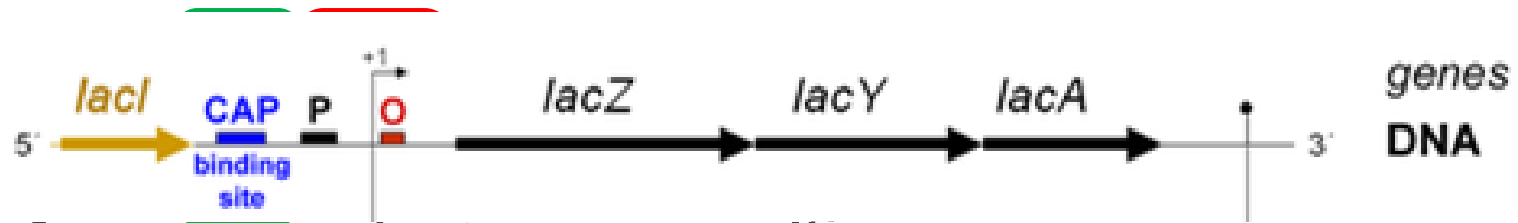
In a Nutshell

Biological Programming

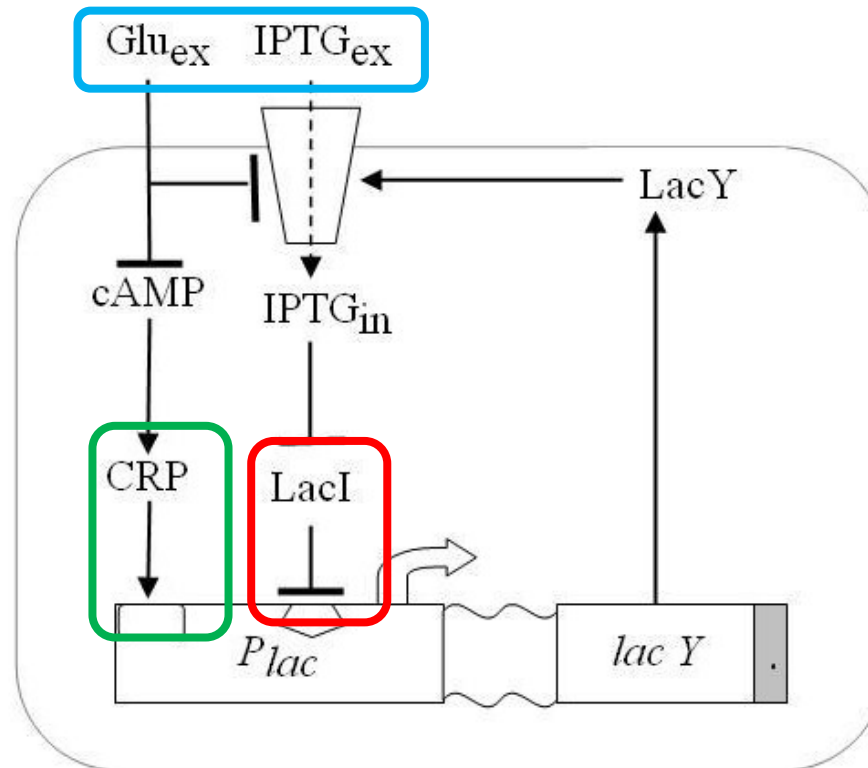
HP: Simplifying Circuits

Explaining our system





- Informative, but unappealing

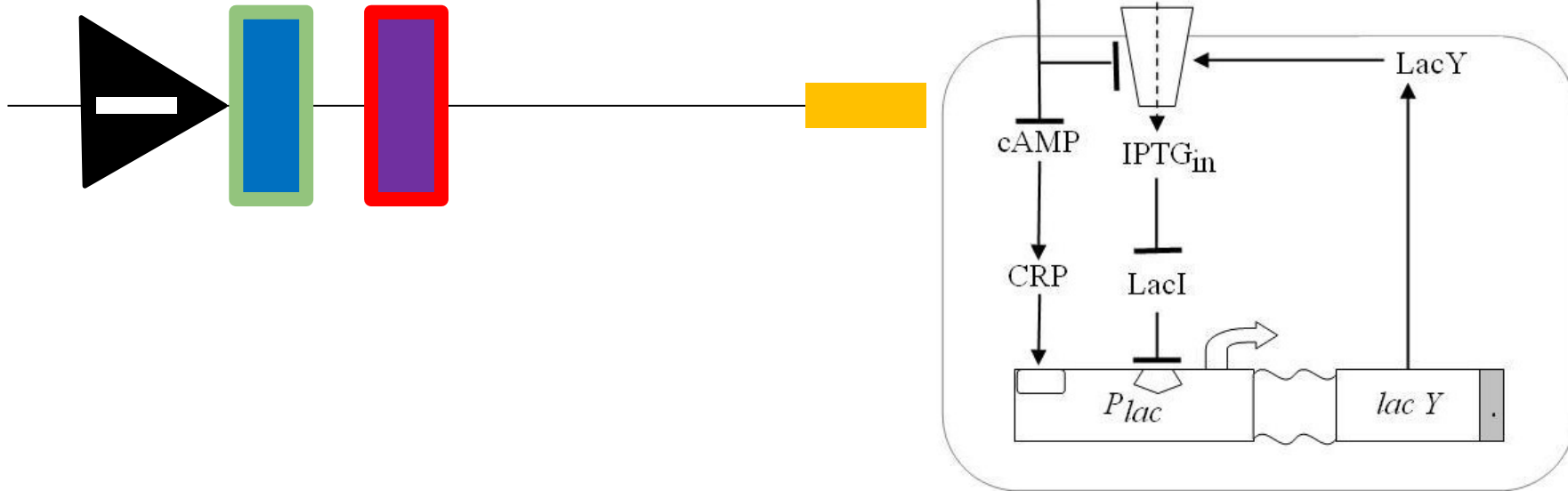


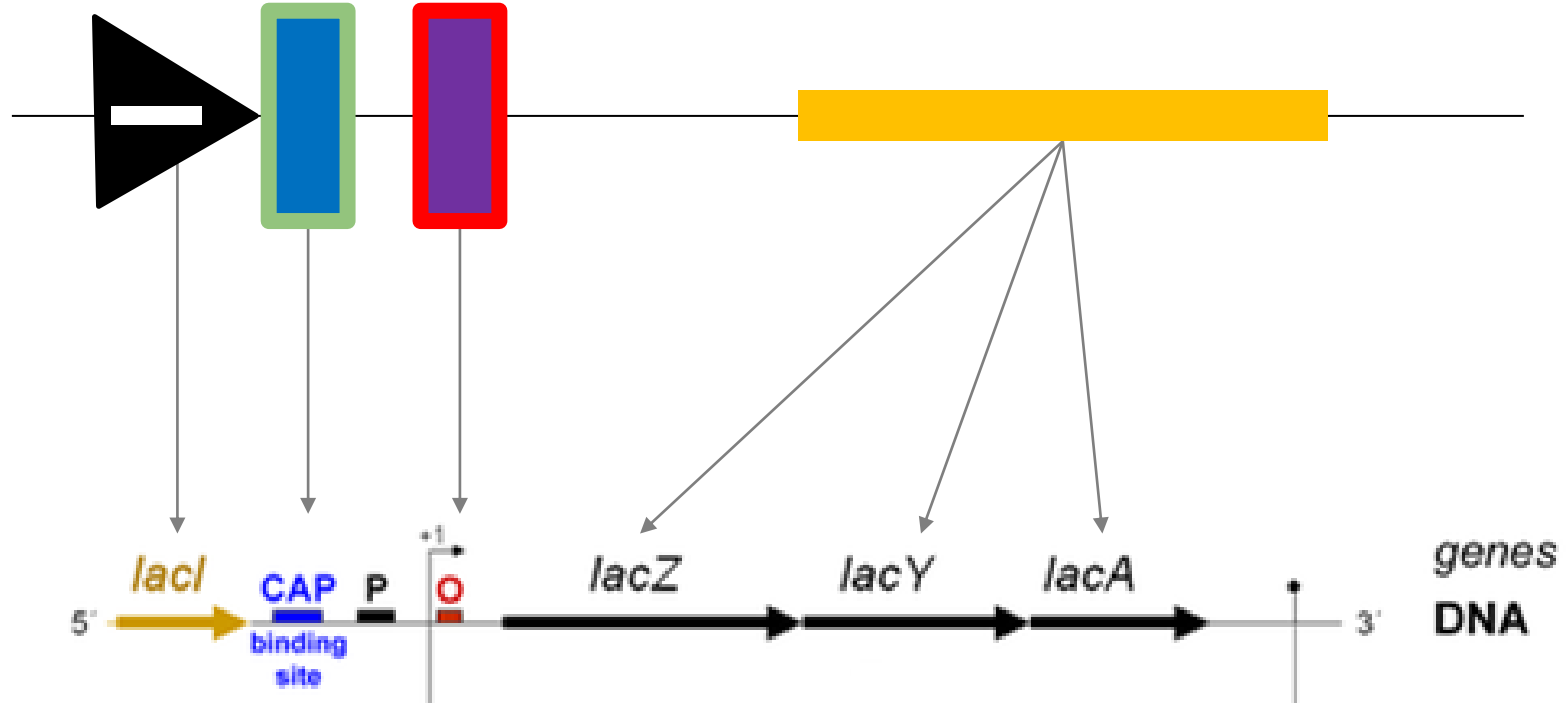
Brute-force representation



Simplified genetic circuits

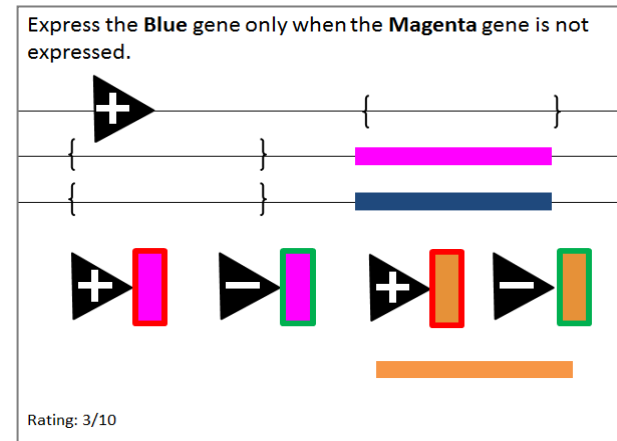
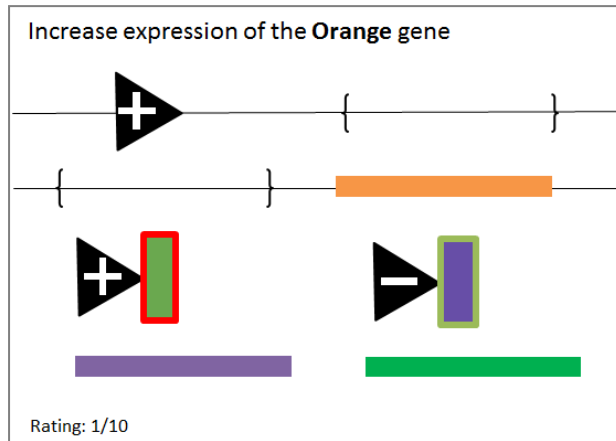
- A teaching tool to introduce genetic circuit designing
 - Simplified abstraction of genetic circuit elements





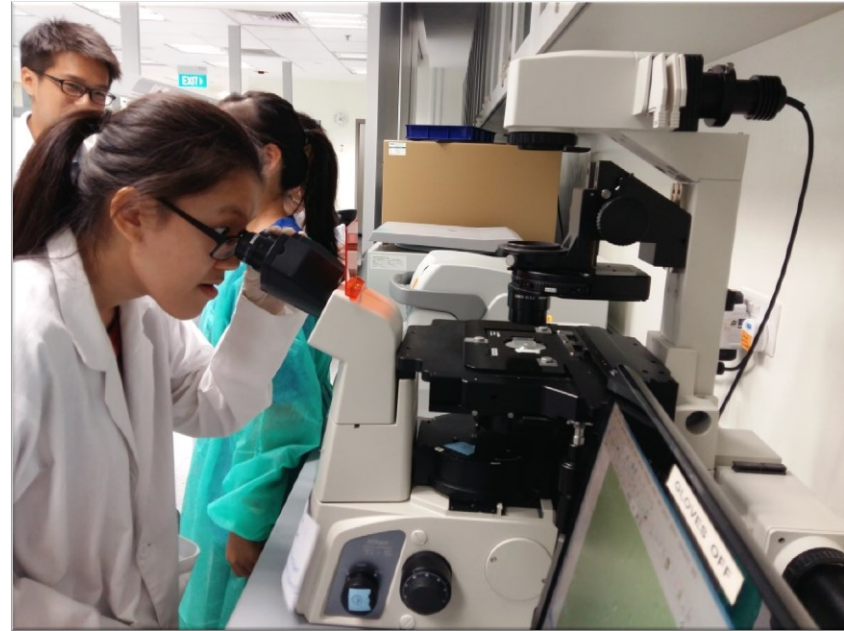
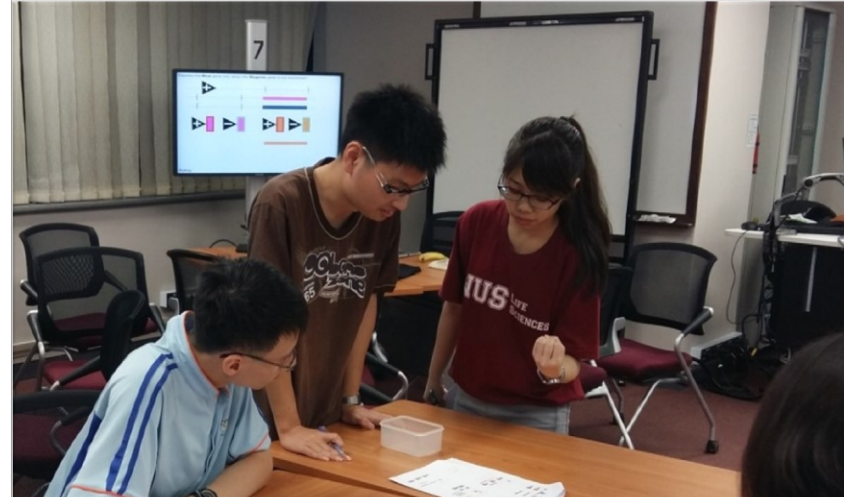
Workshop use

- To test the tool, we integrated it into a workshop.
- Presented it as a set of puzzles
 - Varying levels of difficulty
 - Multiple ways of obtaining the solution

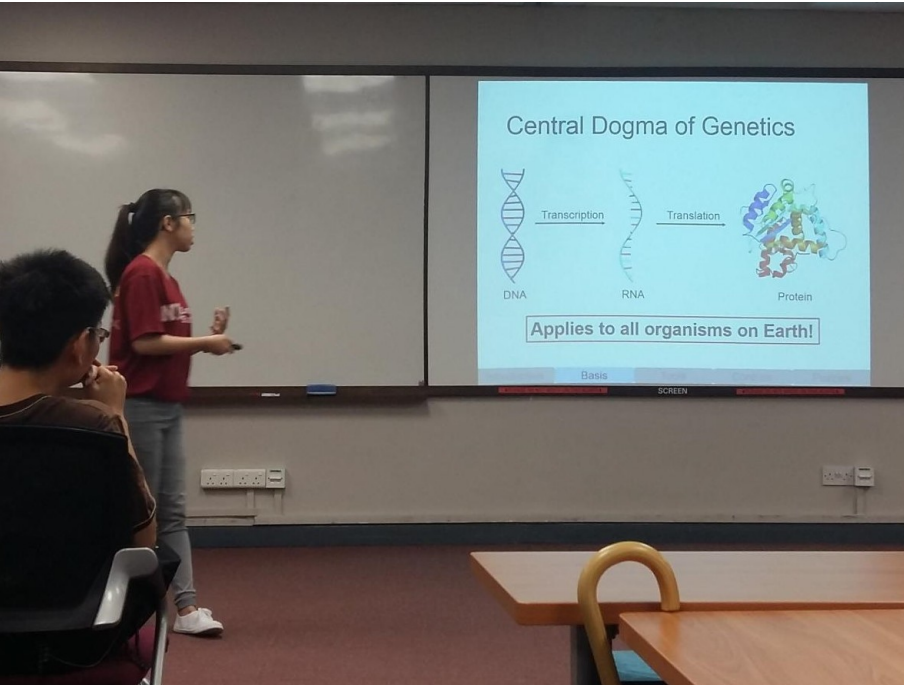


Workshop

- One-day workshop
 - Mostly first-year biology students, and some participants from other disciplines
 - Theoretical and experimental components



Introduction & Theory



Quick introduction to genetics



Genetic circuit puzzles

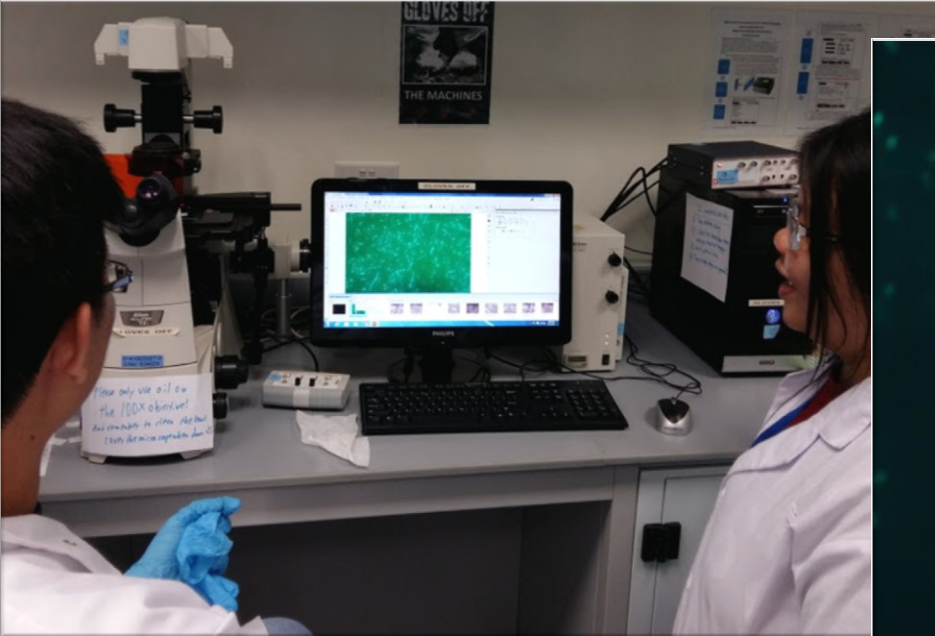
Wet lab: Fusion PCR



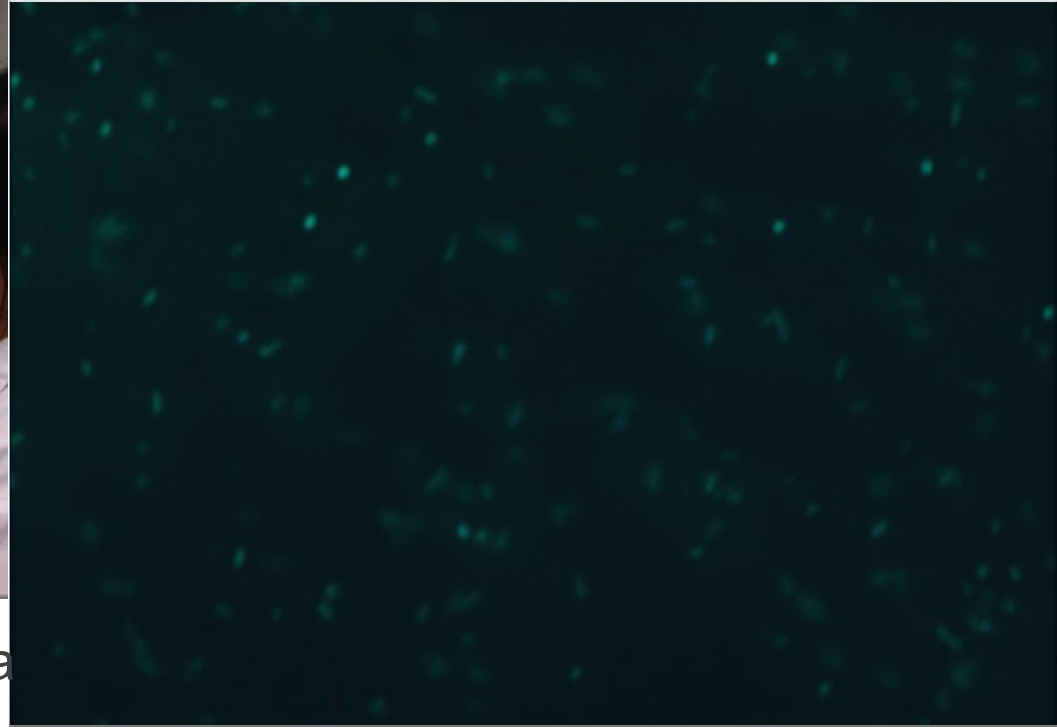
Basic Laboratory Training

Introduction to gel electrophoresis

Wet lab: Bacteria with GFP



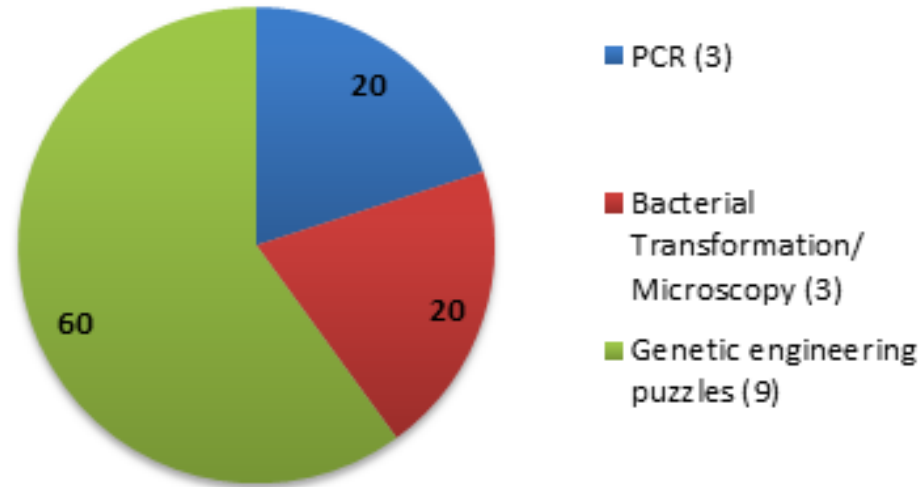
Viewing GFP-transformed bacteria



Microscope view

After the workshop

- Most enjoyed the workshop, with puzzles being the most popular.
 - Non-biology majors picked up on the puzzles fairly quickly.
- Participant understanding



After the workshop

- We also sought further feedback from educators.
 - Received interest in developing it for science outreach
- Ideally we would like to develop the tool further, and make it open-access.

What we've done this summer

- Designed a dual-switch system
- Submitted three parts to the BioBricks registry
- Developed an educational tool on genetic circuits
- Conducted a workshop testing the tool

THE END

We would like to thank:

Special Programme in Science

Faculty of Science, National University of Singapore

Mentors: Dr. Leslie Gapter, Prof. Linda Kenney, Dr. Stuti Desai

Integrated DNA Technologies

